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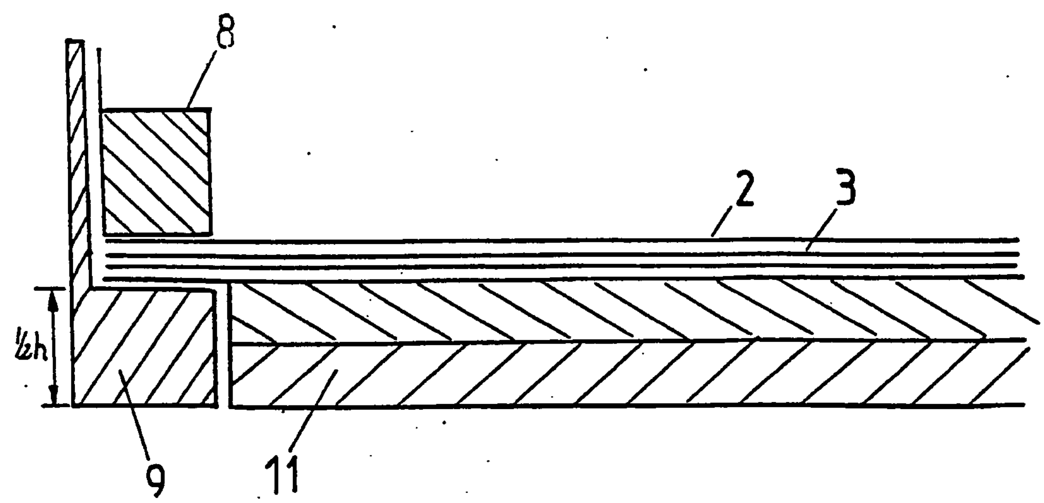
(54) Title: CATALYST PACK SUPPORT IN AMMONIA OXIDATION BURNER



(57) Abstract

The present invention relates to a catalyst pack support structure in an ammonia oxidation burner which comprises a catalyst pack (2), a catchment pack (3) and possibly a support screen (4) being supported by a structure placed in a basket or similar means secured to the burner structure. The support structure (11) consists of a porous, inert refractory material cast into at least one rigid segment (11a-h) assembled into at least one layer and/or fibre mats. Said support structure is substantially dimension stable during operation of the burner and has an even and average porosity of 60-90 %. The segments (11a-h) may be interlocked by means of grooves (13) and tongues (12) in each segment.

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Catalyst pack support in ammonia oxidation burner

The present invention relates to a catalyst support structure in an ammonia oxidation burner which comprises a catalyst pack, a catchment pack and possibly a support screen being supported by a structure placed in a basket or similar means secured to the burner structure.

In a conventional ammonia oxidation burner a mixture of NH_3, O_2 and N_2 react at elevated temperature and pressure over a platinum metal catalyst to nitrogen oxides. Volatilized platinum is collected by the getter material, for instance a palladium-gold alloy. Typically, both the catalyst and catchment material comprise a woven gauze and accordingly several such gauzes made into a pack secured to the burner structure by clamping means. The catalyst/catchment pack is placed on a support in the burner. The most commonly used type of support is ceramic rings, Raschig rings, placed in a basket secured to the burner structure. Usually a support gauze of woven or knitted nonprecious metal, for instance "Megapyr", is placed between the main support and the catalyst/catchment pack. Such conventional burners are further described in Ullmanns Encyclopedia, Vol. 20, pages 314-317, 4th Ed.

The main problem with this arrangement is that during operation the Raschig rings become more closely packed, partly due to disintegration. This results in an uneven surface of the Raschig ring layer causing cracks and rupture in the precious metal gauzes resting on the support. Especially around the outer edge of the gauzes the damage might be severe due to the lowered level of the Raschig rings there. Further, the above described changes in the support layers will result in uneven gas distribution through said layer. Another disadvantage with this type of support is related to its handling during installation. Filling and emptying the basket with ceramic rings is laborious and time-consuming and the weight of a full basket is quite substantial.

However, the main disadvantage of the above described support is the damage it causes on the pack and thereby the reduction of its life-time resulting in shortened operation of the burner or "campaign" between each change of catalyst pack. Higher running cost due to increasing uneven gas distribution in the support layer during operation and its influence on the process equipment after the burner is also quite important.

US-patent No. 3,993,600 describes another type of support for the catalyst pack. The support comprises a plurality of essentially identical woven screens in stacked relationship and made of a specific heat resistant alloy consisting essentially of Al, Cr, Co and Fe. The screens are preferably spot welded at various points to provide an integral assembly.

This arrangement will give a fairly even upper surface of the support during operation, but the insulating effect obtained by a Raschig ring layer will be lost. Such insulation is necessary for damping temperature variations during operation. The weight of these steel screens is rather large resulting in heavier

structure of the complete burner system. Handling and installation of the screen assembly are also complicated. All these disadvantages explain why the conventional use of Raschig rings has not been substituted by this arrangement throughout the nitric acid industry.

The object of the present invention was to overcome the above described disadvantages and problems related to conventional ammonia burners. More specifically the object was to arrive at a support structure that would not cause damage to the catalyst pack during operation of the burner.

The inventors started their development by studying more thoroughly the conventional support system using a basket of Raschig rings. This system has its obvious disadvantages as discussed above. However, there must be reasons, aside from conservatism, for having used this system for decades. These studies revealed that the known support possesed an advantageous insulating effect necessary for damping temperature fluctuations during operation and had, early in the campaign, a positive effect on the gas distribution. The critical pressure drop over the support was reasonable and should not be increased by a substitute support. Thus the following requirement for a new support was postulated:

a) It should be dimension stable during operation of the burner for a large number of campaigns. This implies that the material to be used should be resistant to thermal shocks during start-up/stop of the burner and also inert to the gases present. Thermal expansion should be lower or equal to that of the gauzes.

b) The porosity of the support should be about the same as the known one or at least result in a lower pressure drop.

c) The support should have a certain insulating capacity for damping temperature fluctuations.

d) The weight of the total support should be lower and its handling during installation should be less labour consuming than for the old system.

These partly conflicting requirements had to be considered when choosing new material and configurations for the support. Firstly, it was imperative that the material was inert at the operating conditions of the burner. Several types of ceramic and refractory materials were tested and found acceptable. However, some disintegrated during testing due to the thermal shock they were exposed to. This disintegration produced dust and would inherently lead to increase and maldistribution of the pressure drop over the support. The major prerequesite was that the support should be dimension stable. To fill a basket with particles was rejected as too impractical. However, if refractory material was cast into porous segments and assembled to form a complete support, it was possible to obtain a support structure having about the same pressure drop and insulating effect as the conventional Raschig ring support. The new type of support was found to be substantially dimension stable and having a constant pressure drop and even gas flow during operation. Thus the most serious disadvantages of the conventional support could be overcome.

Refractory material in the form of mats of fibres also looked promising as support structure though the desired porosity was difficult to achieve.

Assembling of such segments to cover the whole burner cross-section disclosed a new problem. These sections could not be placed too close together because they would expand somewhat when heated to operating temperature. Accordingly, there would, at least for some time during start-up/stop, be openings between these sections resulting in uneven gas distribution through the support. Then it was found that this problem could be overcome by using several layers of support segments securing relative displacement of the segments such that there would not be any continuous openings between segments throughout the total support. Further development showed that the above problem could also be solved by having segments comprising groove and tongue and linking the segments together or by using fibre mats.

The type of refractory material useful for a support according to the invention was further investigated and it was found that it should have the following properties: Low thermal expansion coefficient, preferably somewhat lower than that of the catalyst/catchment pack, being inert to the gases present at operating conditions, and rigid sections/segments or fibre mats should be possible to make from the refractory material. The following types of materials were found acceptable: aluminium oxides, aluminium silicates, zirconia and silicon carbide.

The inventors thus found that a support structure according to the invention should consist of a porous, inert refractory material cast into at least one layer of rigid segments and/or fibre mats. The support structure should be substantially dimension stable during operation of the burner and have an even and average porosity of 60-90%. Preferably the support structure comprises 2-4 layers of segments and said layers should be displaced relative each other for securing even gas distribution through the complete support. The segments can

also consist of one layer of segments interlocked by means of grooves and tongues in each segment. The most preferred support material is refractory aluminium oxide cast into segments having a porosity of 75-90%. A support structure consisting of a combination of rigid segments and fibre mats of refractory material have been found to be most advantageous. The primary function of the fibre mats is to secure even gas flow through the support. The mats are used to cover the openings between the segments and between the segments and the burner wall.

The scope of the invention is as defined by the attached claims.

The invention will now be further explained with reference to the description of the enclosed figures and example:

Fig. 1	shows a conventional ammonia burner arrangement for gauze pack and support at start-up.
Fig. 2	shows a vertical section view of the conventional arrangement after som time of operation.
Fig. 3	shows a vertical section view of the arrangement of gauze pack and support according to the invention.
Figs. 4a-b	show a top plane view of supports according to the invention.
Fig. 4c	shows a special type of support segment.

Fig. 1 shows schematically an ammonia oxidation burner 1, comprising a catalyst layer, usually in the form of a plurality of woven gauzes 2 of Pt/Rh wire. Further the catchment layer 3 of getter material, for instance a palladium-gold alloy in the form of woven gauzes. All these gauzes form a pack resting on a steel screen 4 supported by a layer 5 of Raschig rings placed in a basket 6. The gauzes 2 and 3, the screen 4 and the basket 6 are all secured to the rim of the burner along its circumference. During installation of a new pack the upper part 1 of the burner is removed. A new layer of Raschig rings can also be installed, but usually not each time the pack is changed.

Fig. 2 shows a vertical section view of a conventional catalyst and catchment gauze pack and its support at the end of a campaign. Now the Raschig ring 7 is more closely packed than at start-up and some have cracked and disintegrated to small particles during the operation of the burner. The initial overall height of the Raschig ring layer is h. A typical value is h = 0.2 m. The catalyst pack 2, the catchment pack 3 and the support screen 4 are secured to the circumference of the burner in a notch 9 by fixing weights 8. The basket 6 is also secured to the burner wall at about the same place. The most likely places for damage to the gauze pack are indicated by reference number 10.

Fig. 3 shows the same section of the burner as Fig. 2, but with a support 11 according to the invention. The height of the support 11 is in Fig. 3 stated to be 1/2 h, but its height will depend somewhat on the support material. As can be seen from Fig. 3 the upper surface of the support 11 has not changed during operations. There are no uneven points or "hills and valleys" causing damage to the gauzes and there is in fact no real need for a support screen between the support 11 and the catchment gauze 3.

Figs. 4a and b shows a top plane view of two types of arrangement of the support 11. The complete support 11 in the basket 6 (Fig. 3) consists of two layers of segments. The two layers are somewhat displaced relative each other to avoid channeling between the segments. How many segments a-h the support shall be divided into is a practical question related to the size and weight of each segment. A central segment z as shown in Fig. 4b is of interest for burners having large diameters.

Fig. 4c shows another arrangement for avoiding channeling through the support 11. Each segment is equipped with groove 13 and tongue 12. Assembly of such segment to a complete support 11 will result in a one layer support with no channeling effect and still allowing each segment to expand somewhat.

Example 1

This example shows pressure drop across a conventional support (R) (Raschig rings) and a support structure I according to the invention (cast refractory aluminium oxide). The height h of the support layer was in both cases 100 mm. Pressure drop ΔP in mm water column.

Gas flow m/s	Support R ΔP	Support I ΔP
0.5	5	11
1.0	15	17
1.5	31	31
2.0	53	59
2.5	78	89

The ΔP for these two types of support is about the same for the same height h. It was found that the height of the support according to the invention could be about half that of a conventional one and still have the required insulating capacity. Accordingly, the ΔP across the new support will be far lower than for a conventional one.

The new support structure according to the invention is substantially dimension stable and has an even upper surface throughout the operating campaign. The result of this is that the catalyst and catchment gauzes are not damaged by the support. Special support screens will not be necessary as the catalyst/catchment pack can rest directly on the new support structure. The pressure drop over the porous refractory support is less than for conventional Raschig ring support and the gas flow through the new support is even throughout the campaign contrary to that of the conventional support. The weight of the support is lower than that of conventional ones and it is easy to handle and install. All these advantages of the new support will result in longer operating campaigns, lower running costs and somewhat simpler burner structure.

Claims

1. A catalyst pack support structure in an ammonia oxidation burner which comprises a catalyst pack (2), a catchment pack (3) and possibly a support screen (4) being supported by a structure placed in a basket or similar means secured to the burner structure,
c h a r a c t e r i z e d i n t h a t
support structure (11) consists of a porous, inert refractory material cast into at least one rigid segment (11a-h) assembled into at least one layer and/or fibre mats.

2. Support structure according to claim 1,
c h a r a c t e r i z e d i n t h a t
the support structure is substantially dimension stable during operation of the burner and having an even and average porosity of 60-90%.

3. Support structure according to claim 1,
c h a r a c t e r i z e d i n t h a t
the support structure comprises 2-4 layers of segments (11a-h) and that said layers are displaced relative each other for securing even gas distribution through the complete support (11).

4. Support structure according to claim 1,
c h a r a c t e r i z e d i n t h a t
the segments (11a-h) are interlocked by means of grooves (13) and tongues (12) in each segment.

5. Support structure according to claim 1, c h a r a c t e r i z e d i n t h a t the structure (11) comprises aluminium oxide cast into a plurality of segments (11a-h) having a porosity of 75-90%.

6. Support structure according to claim 1, c h a r a c t e r i z e d i n t h a t the support structure consists of rigid segments (11a-h) and fibre mats of refractory material covering the expansion openings between the segments (11a-h) and between the segments (11a-h) and the burner wall (9).

Fig.1

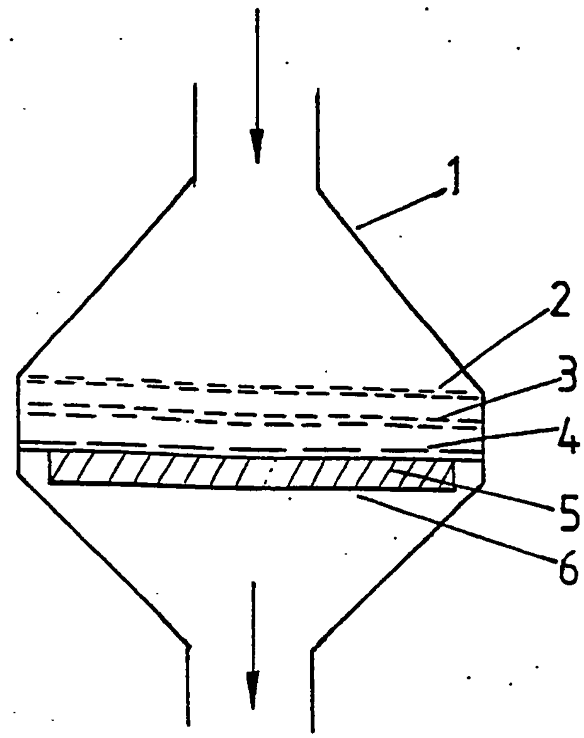


Fig.2

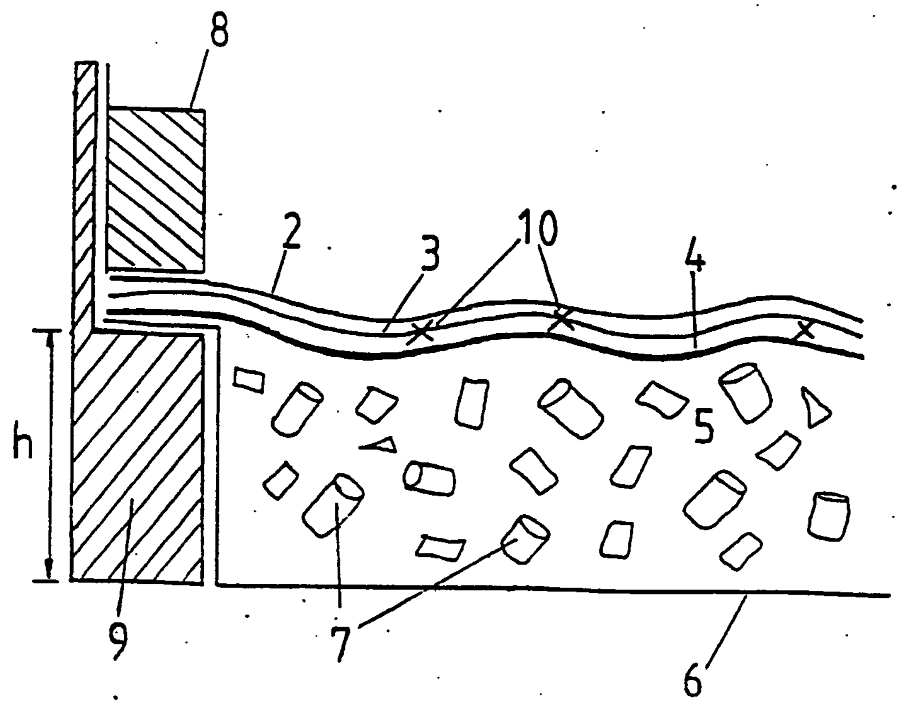


Fig.3

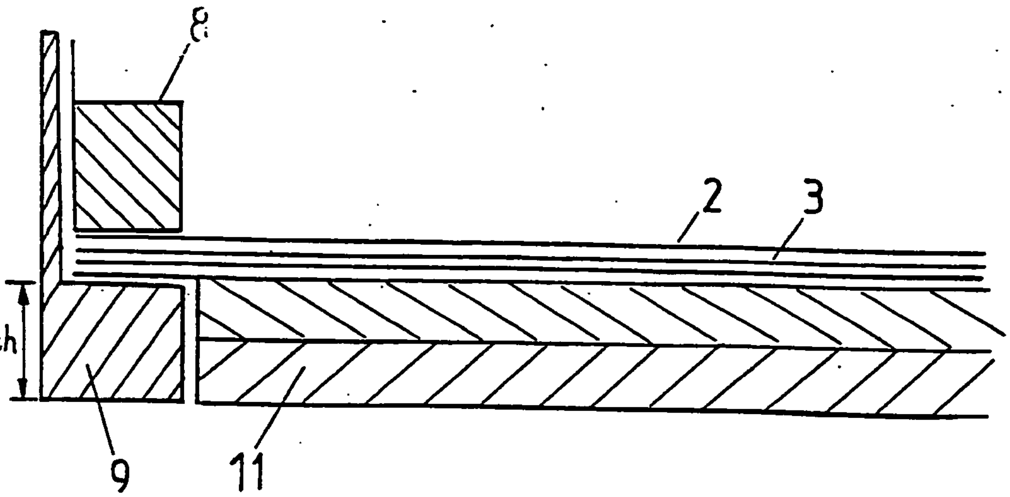


Fig.4c

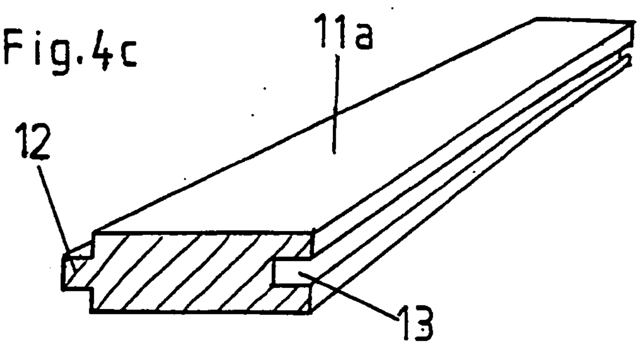


Fig.4a

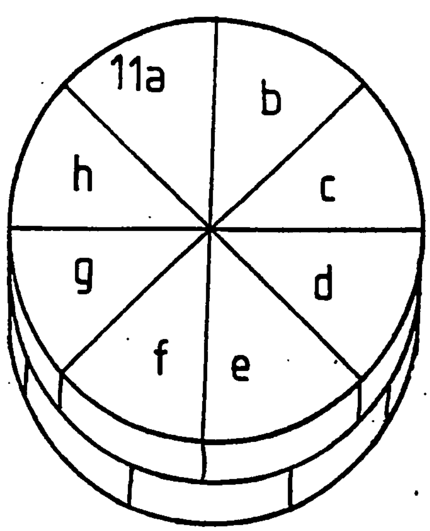
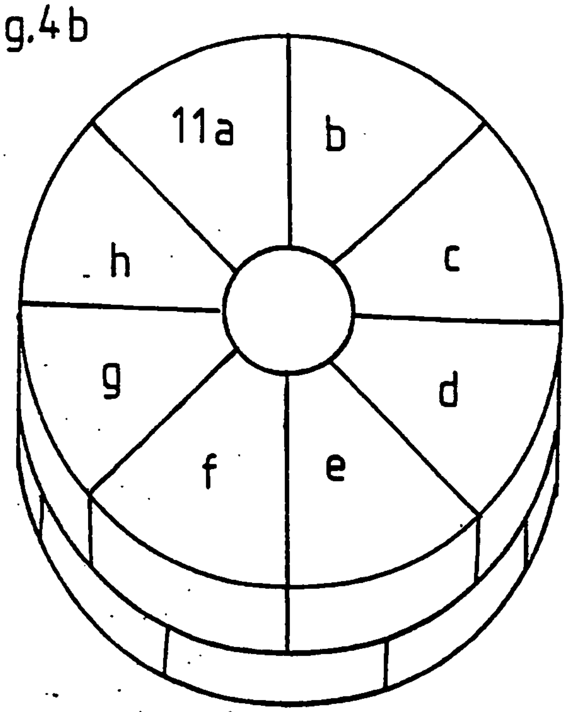


Fig.4b



INTERNATIONAL SEARCH REPORT

International Application No PCT/NO 90/00169

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC5: C 01 B 21/26

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
IPC5	B 01 D; B 01 J; C 01 B

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in Fields Searched[8]

SE,DK,FI,NO classes as above

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category *	Citation of Document,[11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No.[13]
A	EP, A2, 0185510 (JOHNSON MATTHEY PUBLIC LIMITED COMPANY) 25 June 1986, see page 5, line 3 - page 6, line 23; page 8, line 7 - line 22 --	1-6
A	WO, A1, 8603479 (JOHNSON MATTHEY PUBLIC LIMITED COMPANY) 19 June 1986, see page 6, line 8 - page 7, line 20 --	1-6
A	DE, C2, 2754643 (DAVY MCKEE AG) 12 January 1989, see the whole document --	1-6
A	EP, A2, 0207694 (JOHNSON MATTHEY PUBLIC LIMITED COMPANY) 7 January 1987, see the whole document --	1-6

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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
27th February 1991	1991 -03- 07
International Searching Authority	**Signature of Authorized Officer**
SWEDISH PATENT OFFICE	Britt-Marie Lundell

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ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO.PCT/NO 90/00169

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WO-A1- 8603479	86-06-19	GB-A-B- 2141042	84-12-12
		EP-A- 0204696	86-12-17
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DE-C2- 2754643	89-01-12	NONE	
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		JP-A- 62017010	87-01-26
		US-A- 4774069	88-09-27